

COMPLEX ROLE OF SECONDARY ELECTRON EMISSIONS IN DUST GRAIN CHARGING IN SPACE ENVIRONMENTS: MEASUREMENTS ON APOLLO 11 & 17 DUST GRAINS

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Abstract

Dust grains in various astrophysical environments are generally charged electrostatically by photoelectric emissions with radiation from nearby sources, or by electron/ion collisions by sticking or secondary electron emissions. Knowledge of the dust grain charges and equilibrium potentials is important for understanding of a variety of physical and dynamical processes in the interstellar medium (ISM), and heliospheric, interplanetary, planetary, and lunar environments. The high vacuum environment on the lunar surface leads to some unusual physical and dynamical phenomena involving dust grains with high adhesive characteristics, and levitation and transportation over long distances. It has been well recognized that the charging properties of individual micron/submicron size dust grains are expected to be substantially different from the corresponding values for bulk materials and theoretical models.

In this paper we present experimental results on charging of individual dust grains selected from Apollo 11 and Apollo 17 dust samples by exposing them to mono-energetic electron beams in the 10-400 eV energy range. The charging rates of positively and negatively charged particles of ~ 0.2 to $13 \mu\text{m}$ diameters are discussed in terms of the secondary electron emission (SEE) process, which is found to be a complex charging process at electron energies as low as 10-25 eV, with strong particle size dependence. The measurements indicate substantial differences between dust charging properties of individual small size dust grains and of bulk materials.